TAILINGS POND DUST ABATEMENT STUDY

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Western Mining Divisions Engineering Department
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INTRODUCTION

To take effective steps toward the abatement of tailings dust originating from the Ray Mines Division impounded tailings, an evaluation study of methods and equipment used at the Utah Copper Division was made in compliance with the request made by Mr. A. P. Morris in his letter to Mr. S. D. Michaelson dated May 18, 1960. Similar information was obtained from the Nevada Mines Division, and in addition, the Utah State University was approached for information on crust forming coatings and for the treatment of water surfaces to reduce water loss by evaporation. These findings, developed with the assistance of the Industrial Hygiene section of WMD-ED, and conclusions, are contained in this report.

SUMMARY AND CONCLUSIONS

At the Utah Copper Division where the tailings disposal area is one large active pond of approximately 5,000 acres, a number of experiments in crust forming have been tried on the drained areas. Only a small degree of success was obtained. Considering the cost per acre for treatment, and the difficulty of transportation on the tailings area, it was concluded that spraying areas where the surface had dried, using crust forming solutions, was not an economic approach to controlling the dust problem.

The most successful results on dust control to date have been obtained with the use of a "Teracruzer", which is a large tire vehicle developed for swamp use. It can traverse wet areas to reach the dry areas where it is used to plow furrows.

The tailings disposal area at the Nevada Mines Division is composed of an 875 acre inactive area as well as the active ponds. In the inactive area, during the past 10 or 12 years, considerable effort and funds have been expended for experimental planting for dust control purposes. The overall results, as they appear at the present time, are rather discouraging unless this area is considered permanently inactive and any minor degree of success might be considered worthwhile. No attempts are being made to keep tailings in the active ponds from becoming air borne.

The conclusions from this evaluation study for tailings dust control methods for the Ray Mines Division are as follows:

1. Institute experimental plowing of furrows in dry areas using modified existing equipment, or contract the work.

2. If results of (1) above are favorable, purchase a suitable tractor equipped with a furrowing plow.

3. In tailings areas which will be dry and undisturbed for several years, try experimental planting only if plowing of furrows does not give acceptable results. In this regard, the information on Nevada Mines Division's experimental planting contained in this report should be supplemented with information forthcoming from the Boyce Thompson Arboretum. The University of Arizona and Arizona State University should be approached for additional information.

DUST ABATEMENT STUDY

The Utah Copper and Nevada Mines Divisions have, during the past 10 years, spent considerable time and effort in attempting to prevent tailings in impounded areas from becoming air borne. There are two types of tailings ponds, or areas, referred to in this report. These areas are the "active" and "inactive" ponds. An "active" pond is one into which current tailings slurry is flowing. The "inactive" pond is one from which the flow of tailings slurry has been diverted. A pond upon becoming "inactive" goes through a drying period of several months after which the operation of building up the peripheral dike is begun, or, as in the case at McGill, it pertains to an area that has received no tailings for years, and there are no plans in the foreseeable future to again make this specific area active.

Aside from visiting the Utah Copper and Nevada Mines Divisions, additional information was sought from Utah State University by arranging a discussion with Dr. C. W. Lauritzen, soil scientist. His opinion on crust forming coatings was that, as far as he knew, all were tooexpensive. He mentioned a jute fabric that is used for stabilizing beaches and also treated burlap, but both are in the price bracket of 10 cents per square yard. We discussed the use of a monomolecular film to retard evaporation. He referred us to a report on the evaporation suppression test at Lake Hefner in Oklahoma in 1958. According to this report the overall evaporation saving was 9% for an 86 day test period.

Utah Copper Division

The 5,000 acre tailings disposal area ~~is one "active" pond~~ receives about 3 feet per year. A continually shifting delta of tailings covers the entire area ~~in time~~ but while doing so considerable portions of the total area dry out. Some effort has been made to find a type of vegetation that would grow on the pond. This was unsuccessful and all attempts to establish vegetation have been abandoned unless certain areas should be isolated for a period of years to allow plant growth.

In August 1953 a two acre tract was measured and staked out on the tailings pond, and this tract was sprayed with a solution of lignin sulfonate. The trade name of the product used was "Orzan A". It was dissolved at a concentration of one pound per gallon of water. This solution was sprayed on the two acre tract using a half-track truck equipped with a pressure pump and spray header. 4,800 pounds of Orzan A obtained at a cost of $211.20 was applied at the recommended rate of $\frac{1}{2}$ pound Orzan per square yard.

Soon after the application of Orzan a hard crust formed on the surface of the area sprayed. During September 1953, two moderate wind storms and two light rain storms had little effect on this crust. In October a heavy rain occurred resulting in most of the Orzan being washed below the surface and leaving very little hard crusted surface. Shortly after this rain the dust started blowing again. The overall cost of applying this crust forming solution was estimated to be $410 for two acres, with an effective life limited by the duration of the dry weather.

In June 1955 a tailings area of 120' by 60' was sprayed with 1,500 pounds of calcium chloride dissolved in 250 gallons of water in an effort to keep the tailings surface moist. By July 6th dry patches began to appear and by August 19th the sprayed area was dry enough to blow.

Also in June 1955, an attempt was made to spray an area 10' by 150' with a mixture of agricultural gypsum and 250 gallons of water. The gypsum settled out rapidly causing spraying difficulties and the project was abandoned. In a second attempt the gypsum was placed in a dry mechanical spreader. However, the spreader could not get enough traction on the loose tailings and this attempt was also abandoned.

Over a period of several years an attempt has been made to minimize the dust problem by the use of water sprinklers on the dry areas. This has been a rather unsatisfactory solution. However, it was at this time that need for a safe and reliable means of transportation over the wet areas became apparent. This led to an investigation of various types of conveyances developed for swamp use. In 1959 the FWD Teracruzer was purchased. It resembles a large flat bed truck except that it rides on eight large "sausage" or "bag" type rubber tires, all of which are drivers. This vehicle is currently used primarily for plowing furrows in the dry areas of the tailings pond. The hydraulically controlled plow consists of three V-shaped shovels on about 44-inch spacing and arranged to plow about 12 inches deep. The effect on tailings that tend to blow has been reasonably satisfactory so far.

Nevada Mines Division

McGill, Nevada, has an average annual precipitation of 9.2 inches per year with three inches falling during the 120 days growing season. The maximum temperature is 104° F with a minimum of minus 27° F. The altitude is 6,100 feet. The tailings slurry when entering the disposal area has a pH of 10 to 11. The pH of the tailings in place is 8 or less.

The tailings disposal area is adjacent to the west edge of the town and covers almost six square miles. About 875 acres of the south and west parts of this area have been diked off to prevent further deposition of tailings and to render these parts of the pond permanently inactive. In this area considerable effort has been expended in experimental planting for dust control.

In the fall of 1949, rabbit brush, alkali weed, and Russian thistle(tumble-weed) were gathered while in seed and whiskered into the tailings by discing. The Russian thistle grew quite well, the alkali weed was fair and the rabbit brush showed practically no seedlings. The following year about 10 acres were sewn with barley and three and one half acres were sewn with rye with alfalfa and clover seed included. Both grains grew and headed out well. The alfalfa grew somewhat, but the clover made a better showing with a lot of seed which produced new plants the following spring. Some variations were made in the type and amount of fertilizer applied at the time of seeding. However, most of the areas seeded were fertilized with 400 lbs. of 10-10-5 fertilizer per acre which later became the recommended proceedure. (10-10-5 refers to the proportions of nitrogen, phosphorous and potassium.)

An ordinary grain drill was used for the seeding operation, turning small furrows on 8" centers. Where the surface was caked, fine material, the furrows held shape and the plants grew well. In the more sandy areas the sand blew into the furrows so rapidly that the grain seedlings were smothered.

In 1956 about 100 acres in the experimental area were replanted with wheat-grasses, clover, alfalfa and rye, and irrigated by use of agricultural type sprinklers. In 1957 the overall results were evidently quite encouraging. In a report written that year the statement is made that the amount of dust that blows into the town has been reduced to about one-fourth of what it used to be. There was some planting done in 1958 along with operation of sprinklers. In 1959 labor troubles resulted in nothing being done. In 1960 about 120 acres were planted and the operation of sprinklers was resumed. The overall results of fertilizing, planting and sprinkling as they appear at the present time (June 1960) is rather discouraging. The only clover remaining is in the western part of the inactive area where the west and north side dikes give some protection against errosion and where additional moisture is received as runoff from other parts of the inactive pond. The tamarisk planted in a 100' x 100' test plot over ten years ago appear to be barely surviving and provide very little windbreak. Some rabbit brush grows but too few to have any effect. The results of the 1960 planting could not be evaluated at this time, it being too early in the growing season.

At McGill no attempts were being made to keep tailings in the active ponds from becoming air borne.

Recommendations for Ray Mines Division is that the furrow-plowing method should be tried. This applies to dry areas in an active pond, to a pond temporarily inactive for dike building, or for areas made inactive due to development and use of new tailing disposal areas south of the Gila River. It is to be pointed out that the disposal of tailing in a new area will not render the present tailings ponds "permanently" inactive. It is believed that either in the normal operating cycle of the new area, or in case of emergency, the mill tailings will be diverted temporarily to the old ponds. Also, there is the imminent possibility of retreating the old tailings.

It is recommended that, as a first step, some experimental plowing be attempted, either by adapting some existing equipment, or, contract to have the work done by some local farm equipment owner. Attached Exhibit A shows the recommended design for furrows to protect the Hayden and Winkelman residential areas.

The second step is to investigate the availability of a suitable tractor for pulling the furrow-making plow. The use of a "mass production" item such as a farm tractor will no doubt result in considerable saving. It would, of course, require special tires and in this connection the Goodyear Tire & Rubber Company should be approached. Attached to this report is Exhibit B, which is a copy of a photograph from page 16 of the Goodyear publication "BIG", volume 16, number 2. This shows a conventional farm tractor equipped with "porky" Terra-Tires in use on the Santa Anita race track.

It is possible that, if a new area is developed for tailings, there will be areas on the old ponds that can be predicted to receive no new tailing and can be undisturbed for years. If plowing of such an area is not as successful as desired, efforts should be directed toward experimental planting, taking into consideration the information forthcoming from the Boyce Thompson Arboretum, as well as information in this report. Mr. Bernard Benson, director of the arboretum near Superior, Arizona, met with RMD personnel on June 13, and discussed native shrubs or grasses that might grow on the tailings. Mr. Benson took some samples of tailings for experimental work at the arboretum, results of which will be sent to RMD. Additional information might be obtained from the Arizona State University, and from the University of Arizona Agricultural Department.

The use of a fabric such as jute or burlap, crust forming coatings, and monomolecular films are not recommended.